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I, LEANNE MYNOTT, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PQ 2341 for a patent by MICHAEL RAFFAELE and PETER RAFFAELE filed on 19 August 1999.

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WITNESS my hand this
Eleventh day of April 2000

LEANNE MYNOTT
TEAM LEADER EXAMINATION
SUPPORT AND SALES

This invention relates to fluid pumps and the like. More particularly to engines that have at least two pistons. And more particularly to engines that have two pistons arrayed about a common crank main axis wherein the pistons are angularly displaced from each other so as to form what is known as a Vee configuration.
Preferably the pistons reciprocate along paths that are perpendicular to the crankshafts main axis. The pistons reciprocate in cylinders and the cylinders are capped by cylinder heads. The breathing arrangement of the device may include any suitable means including but not limited to 2 stroke and 4 stroke methods or hybrids of such.
We have disclosed such devices in our earlier applications relating to sinusoidal fluid pumps and engines. The numbers of which that we know of are PP9266, PP9306, PP9537, PQ0287, PQ0795, PQ0895, PQ0989, PQ1653, PQ1654.
We hereby incorporate these applications in this application for use herein. Some of these applications we have not yet received notification of their number and or their date of filing as determined by the A.P.T.O. Never the less we think that some may have been accepted as being filed on the 13th and 14th of the 8th 1999. Other applications we have lodged that are to do with the subject matter of the above and not listed herein we also incorporate.
One of the things we have found is that the decoupled, paired piston/s, scotch yoke devices of our invention may be balanced perfectly in that the centre of mass of the moving parts of the engine (the crank, the pistons and their members, and any interconnecting members between the cranks big end and the pistons) remains exactly stationary and centred on the main axis as the

device members rotate, orbit and reciprocate through its cycle. We have found that a pair of pistons arranged at 90 degrees to each other and sharing the same big end axis as disclosed in the above applications may be perfectly balanced. We have also found that a pair of pistons arranged at 90 degrees to each other and having coaxial big ends, similarly may be perfectly balanced (although in this embodiment a rocking couple may be set up).

We would like to add that a engine that is of a Vee configuration that is other than 90 degrees may be balanced perfectly as well.

This may be achieved by splitting the big end so that there are two big end axis per pair of reciprocating masses ie pistons. The two big ends axis are angularly displaced from one another about the main axis.

If the Vee is more than 90 degrees then the pair of big ends axis are to be angularly displaced from each other about the main axis by twice the amount in degrees that the Vee is larger in degrees than 90 degrees.

If the Vee is less than 90 degrees then the pair of big ends axis are to be angularly displaced from each other by exactly the amount of degrees that the Vee is less than 90 degrees.

The above may be better understood when one considers the non limiting drawings attached hereto;

Figure 1 is a isometric view of a crank with a pair of split big ends.

Figure 2 is a end view of a Vee scotch yoke device according to our invention wherein the big ends are coaxial and the pistons are disposed for reciprocation at 90 degrees to each other about the main axis.

Figure 3 is a end view of a Vee scotch yoke device according to our invention wherein the pistons are disposed for reciprocation at 45 degrees to each other about the main axis.
Figure is a end view of a Vee scotch yoke device according to our invention wherein the pistons are disposed for reciprocation at 120 degrees to each other about the main axis.

Turning now to Figure 1, you can see a crank mechanism with a main axis 1, having two webs 2,3 extending outwards of the main journal 25, the webs support big ends 5 and 4 which have their own respective axis.

Figure 2 is a scotch yoke type device according to our invention wherein the pistons 8a and 8b are disposed for reciprocation at 90 degrees about the main axis 1, the crank has a at least one big end and it has only one axis 10. Note the pistons are constrained to reciprocate along their respective paths A and B, and that A and B are at 90 degrees to one and other. The pistons 8a and 8b are connected to the crank big end/s 10, by way of sliding engagement means 12, as disclosed in our earlier applications. You will note that in this depicted embodiment the engagement means is or are centred on the big end axis and the means are to one side of said big end/s respectively for each piston.
Figure 3 is scotch yoke type device according to our invention wherein the pistons 8a and 8b are disposed for reciprocation along paths A and B at 45 degrees to each other about the main axis 1, and that there are two big ends 100 and 110.

You will note that the path B is rotated 45 degrees clockwise towards the path A and that the big end axis 100 is rotated clockwise 45 degrees away from big end axis 110, and so you will see that the big end is rotated exactly the amount in degrees clockwise that the Vee is less than 90 degrees. This clockwise rotation of the big end 100 is true for all Vee configurations that are less than 90 degrees albeit a differing amount for each amount of degrees that each Vee is less than 90degrees ie a 60 degree Vee would require the big end 100 be rotated 60 clockwise of big end 110. Further big end 100 is for the motion of piston that travels on path B and big end 110 is for the motion of the piston that travels on path A.

Figure 4 depicts a Vee scotch yoke type device according to our invention wherein the pistons are disposed about the main axis at 120 degrees from each other. You will note that the path B is 30 degrees rotated anti clockwise from being at 90 degrees to path A. Further, big end axis 100 is rotated 60 degrees anti clockwise from big end axis 110, this is twice the amount that the Vee is greater than 90 degrees. All Vee's that are greater than 90 degrees require that the big end 100 is rotated anti clockwise to big end 110. As above big end 100 is for the motion of the piston that travels on the path 100 and big end 110 is for the motion of the piston that travels on the path A.

It will be appreciated that the idea is to have the pistons reciprocating in a manner that they are one quarter of a sine wave out from each other. Provided that they are of the same mass the engine will be perfectly balanced. It is also obvious that the crank disk and scotch yoke embodiments of our invention that are of Vee

configuration may be balanced in the same way and that X and horizontal or 180 degree configuration devices of our invention may also be balanced similarly. This may be seen from the Figures 5, 6 , 7. In figure 5 there is depicted, in a end view, a horizontally disposed piston device according to our invention, one may see clearly that the big end 110 is displaced 90 degrees anti clockwise to big eng 100. Clearly the pistons are going to reciprocate at one quarter of a sine wave out from each other.

figure 6 is plan view of a piston device according to our invention in which the pistons are, in line, to one side of the cranks main axis 1, and the big ends are axially displaced at 90 degrees to each other. Clearly the pistons will move at one quarter of a sine wave out from one an other.

It is also clear that a engine designer may wish to construct an fluid scotch yoke type device of a type depicted and written of in our applications wherein a degree of imbalance is in some way preferred, accordingly we would broaden this application to include devices with their big ends displaced at not quite one quarter of a sine wave out from each other, say up to 10%- 20% of the sine wave out of true balance, this would still fit broadly within the scope of the invention.

Figure 8 is a depiction of a sine wave that is created by the connecting means as it orbits the main axis and raises and lowers the piston along its respective path. One can see that it is in graph form and that the graph is broken into quarters and that it has a total duration of 360 degrees and a total amplitude dependant on the throw of the crank. One can see that the graph is marked with 8a,

A and 8b,B these two sets letters correspond to the drawings of this application in that the pistons of the devices of the invention are reciprocating in preferred embodiments are travelling at one quarter of a sine wave (as depicted) out from each other and as well as being displaced angularly in the appropriate direction for the purposes of balancing the device or at least certain parts of it according to the whim or goals of the designer. We trust that the information provided herein is instructive and of some considerable use to you the reader who has heretofore had little reason to plumb the depths of such a murky and snare filled subject. Also for an example of star shaped devices one need only mirror the Vee devices depicted, along a appropriate line that bisects the included angle of the respective Vee and cuts through the main axis. W configuration devices in piston path layout according to the VW company recently newspaper published articles are adaptable to the scotch yoke layouts of our invention.

fig 2

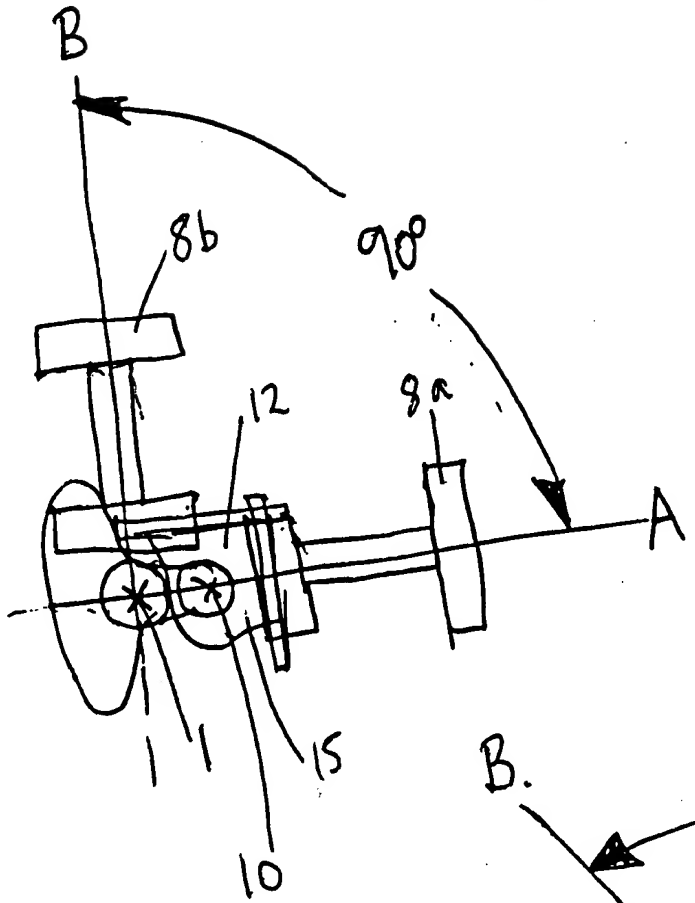
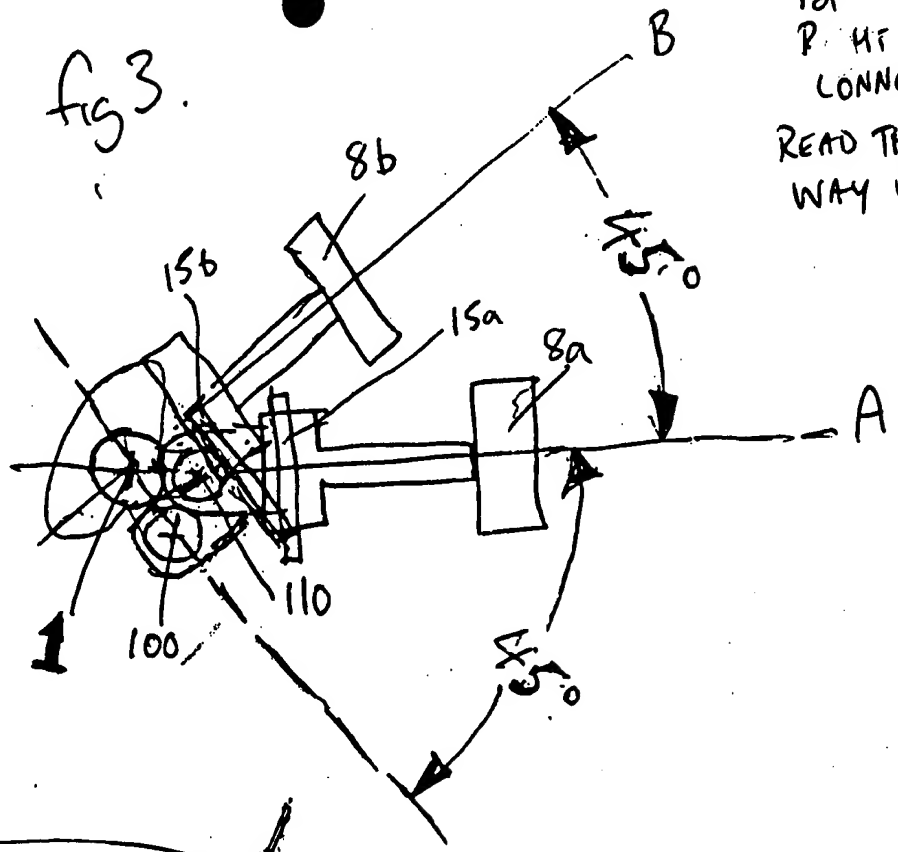


fig 3.



TOP
P HT
CONNE
READ THIS
WAY UP

fig 4.

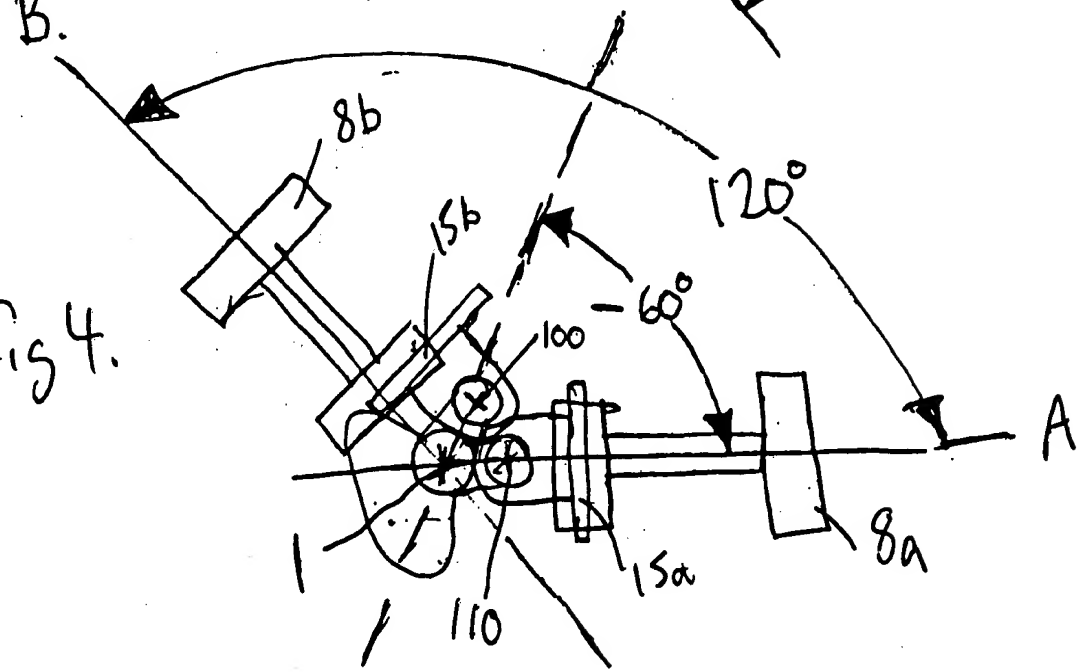


Fig 5

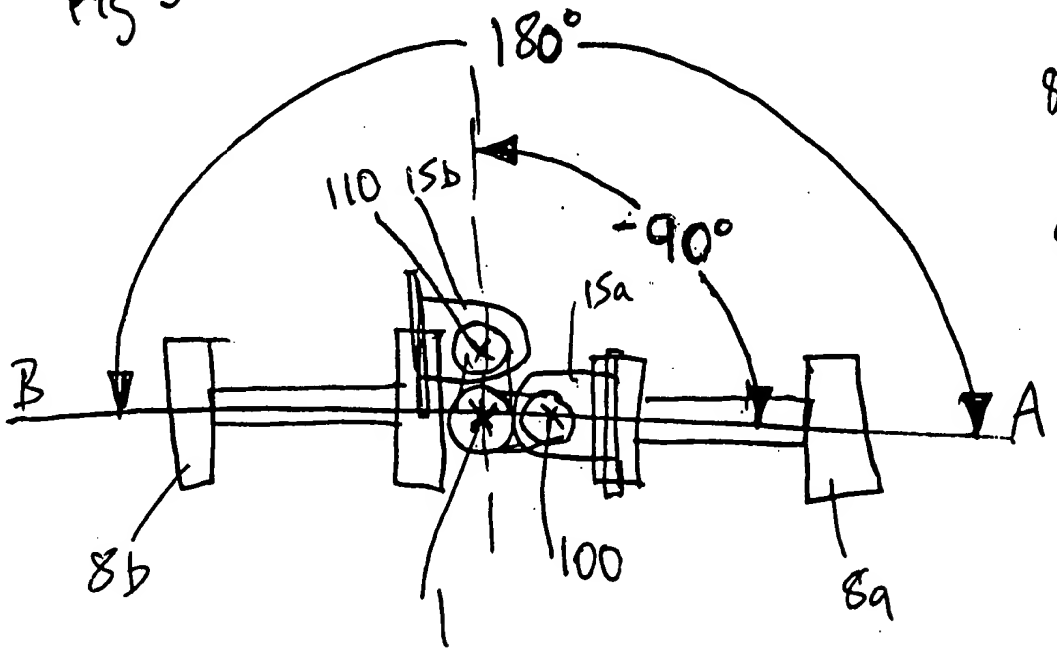


Fig 8

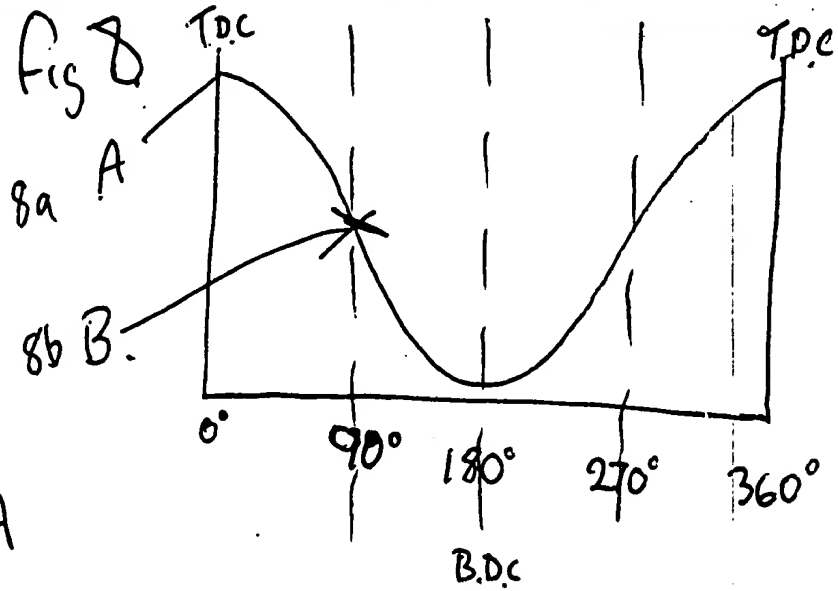
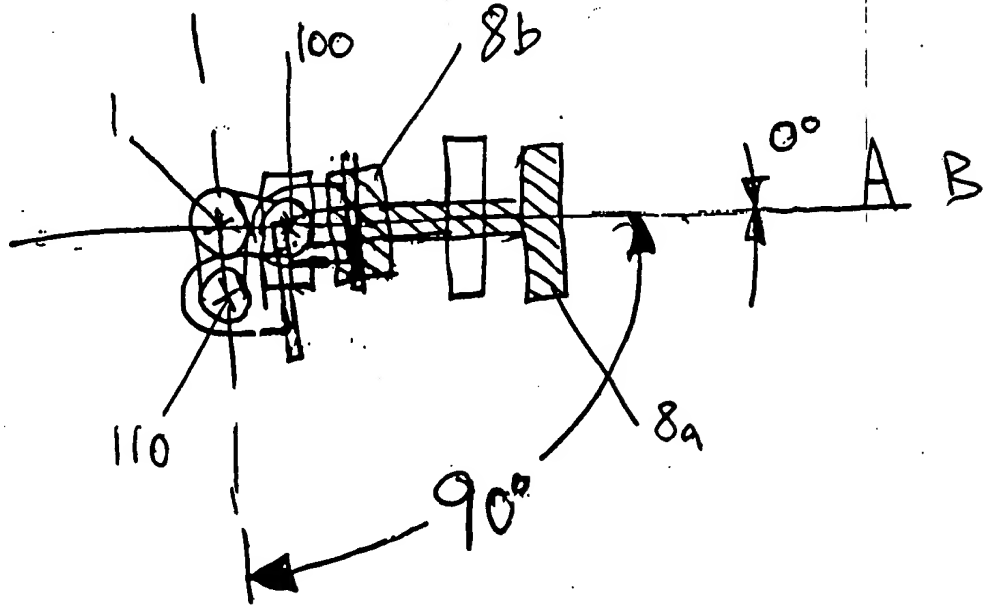
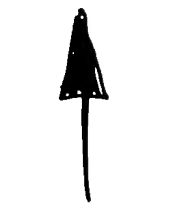
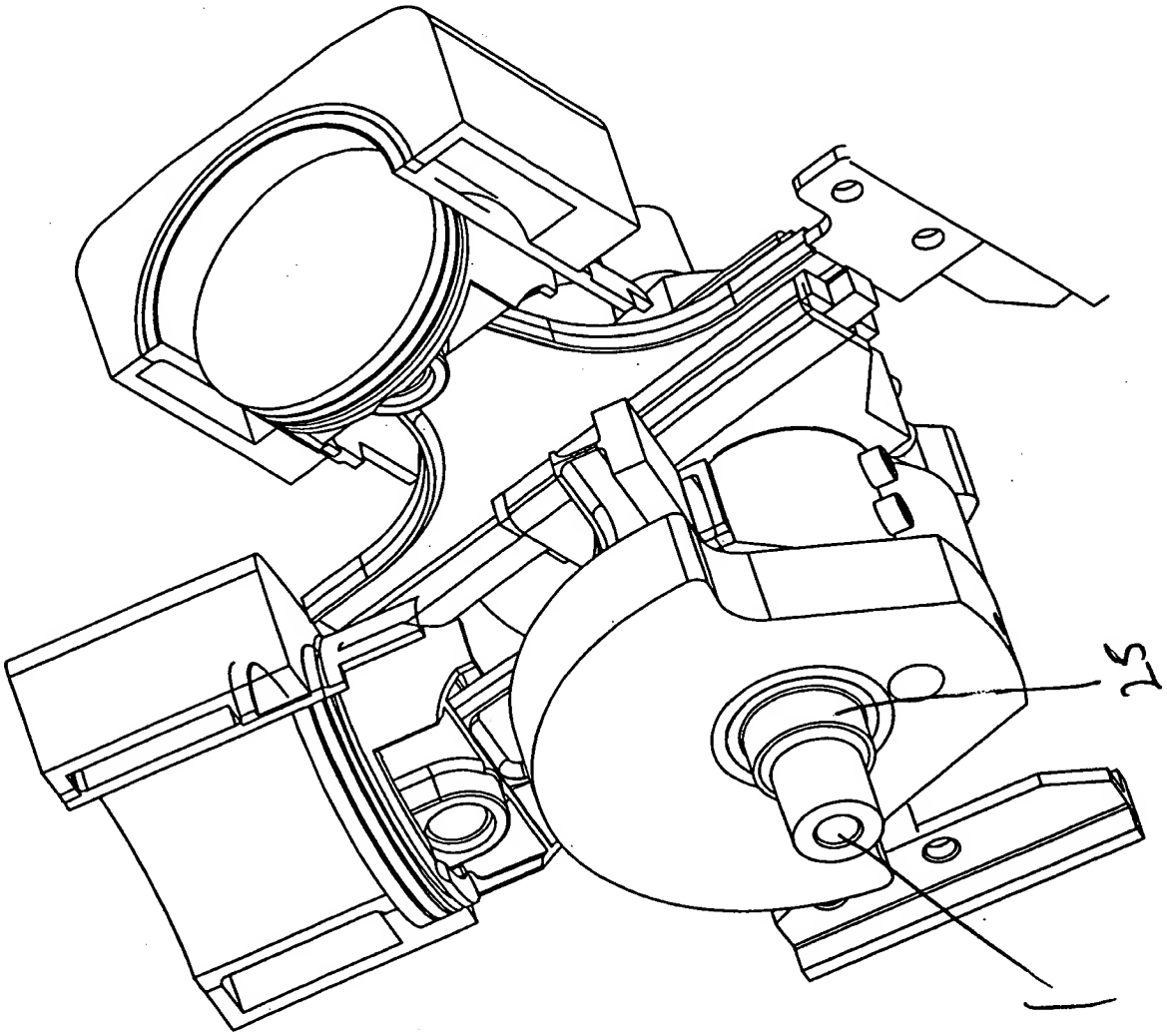


fig 6





THIS WAY UP.



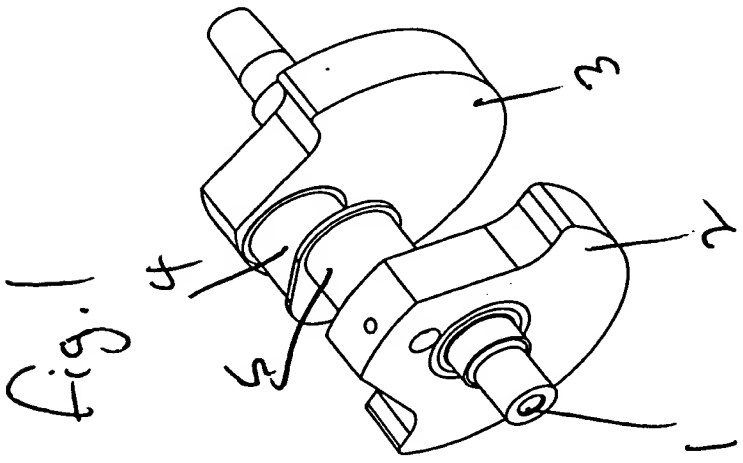


Fig. 1